RH2 ENGINEERS PLANNERS SCIENTISTS

RH2 TECHNICAL

Memorandum

Client:	CDM Smith
Project:	Klamath CAPP Engineering Support Services
Project File:	714.040.01.102 **Project Manager:** Paul R. Cross, P.E.
Composed by:	Ryan M. Withers, P.E.
Subject:	**Klamath CAPP Reserve and Transferred Works Field Testing**
Date:	February 4, 2015

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EXPIRES: 12/31/2015

Executive Summary

This study evaluates the efficiency and energy consumption of the pumping equipment in the Klamath Basin's irrigation systems. RH2 Engineering, Inc., (RH2) requested pump and motor information from the irrigation system owners that own and operate 99 pumping facilities within the United States Bureau of Reclamation's (Reclamation's) Klamath Project. Information was received for 141 pumps and motors at 82 of the 99 facilities (approximately an 83 percent response rate). The information received was evaluated and filtered by RH2 to identify a representative sample of 12 facilities for field testing. This evaluation was conducted by:

1) Performing field pump tests at 12 representative facilities (27 pumps tested in total out of 31 total pumps at these facilities);
2) Determining the energy signatures for the pumps and motors;
3) Analyzing the system in order to recommend:
    a. Improved pump sequencing to minimize the energy consumed with the existing equipment.
    b. Replacement equipment at facilities with inefficient equipment.

4) Estimating the energy consumption and projected energy savings at the remaining 72 Klamath Basin pumping facilities.

Based on the findings of the representative facilities, energy consumption could be reduced by approximately nine percent at each facility if the existing equipment can be resequenced such that the most efficient pumps and motors are more heavily utilized and the least efficient pumps and motors are utilized only when needed to meet the peak demands of the system. The nine percent reduction at each facility results in approximately 444,079 kilowatt-hours (kWh) of energy savings at the 12 field-tested facilities. In most cases the resequencing allows for pump cycling, which allows the inefficient pumps to operate regularly to allow the most efficient pumps to rest. More aggressive resequencing operation could take place by relying exclusively on the pump(s) with the best energy signature, and by not running the pump(s) with the worst energy signatures. The energy consumption could be reduced an additional 5 percent on average (for 14 percent total energy savings) at each facility with an aggressive resequencing program. In addition to possible energy savings due to pump resequencing, the results of the analyses indicate that 12 of the 27 field-tested pumps and motors have a high priority replacement recommendation. If these high-priority pumps are replaced, and the remaining pumps are resequenced, the resulting energy savings is approximately 898,246 kWh compared to existing equipment and sequences on an annual basis, which represents approximately 18.5 percent energy savings (on average) at each facility.

A summary of the estimated annual energy consumption at each field-tested facility is shown in **Table ES-1**, which also shows the estimated annual energy consumption and savings at each facility with revised pump sequences and with new equipment for the 12 high priority replacement pumps and motors. The estimated annual energy savings of Facilities 5 and 7 are shown as negative values in **Table ES-1** because these pumps have better wire-to-water efficiencies and energy signatures than those at Facilities 6 and 8, and it is recommended that these pumps be utilized more than they currently are to optimize the energy savings at each site. The percentage of total energy savings at Facilities 5 and 6, and at Facilities 7 and 8, are grouped because the facilities are in parallel with each other.

Table ES-1
Energy Consumption and Savings Summary

Facility Name	Annual Energy Consumption (kWh)		Estimated Annual Energy Savings (kWh)	Percentage of Total Energy Savings at Each Facility
	Existing Equipment and Sequences	New Equipment and Sequences		
Facility 1	145,650	123,290	22,360	2%
Facility 2	96,840	87,651	9,189	1%
Facility 3	122,869	43,577	79,292	9%
Facility 4	313,736	293,545	20,191	2%
Facility 5	45,492	279,302	-233,810	21%
Facility 6	703,680	279,302	424,378	
Facility 7	13,360	455,508	-442,148	38%
Facility 8	1,350,981	569,385	781,597	
Facility 9	434,305	209,707	224,598	25%
Facility 10	479,043	466,443	12,600	1%
Facility 11	309,244	309,244	0	0%
Facility 12	837,926	837,926	0	0%
Totals	**4,853,126**	**3,954,881**	**898,246**	**100%**

NOTE: Components may not sum to totals due to rounding.

Based on the results of the field-tested facilities that reflect a representative sample of the 82 pumping facilities in the Klamath Project, it is estimated that 9 to 14 percent energy savings can be realized at each facility, on average, by resequencing the existing pumps. With 44 percent of the field-tested pumps having a high priority replacement ranking, it is estimated that 63 of the 141 pumps in the Klamath Project that information was provided for have a high priority replacement ranking. If the high priority replacement pumps and motors are replaced and the remaining pumps are resequenced, the annual energy savings at each facility is estimated to be approximately 16 to 20 percent compared to the existing energy consumption[1]. It is expected that the minimum annual energy savings for each facility is 16 percent (on average), and annual energy savings may be as high as 30 percent (on average) with the replacement of the high priority equipment and resequencing.

[1] Existing flow meters or exposed piping for the strap-on flow meter did not exist at all pumping facilities. Conservative estimates for flow were estimated at these locations based on known parameters and pump owner knowledge.